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METHOD FOR DETERMINING SUITABILITY OF SOLID MEDIUM FOR GROWING ANAEROBES UNDER AEROBIC CONDITIONS WITH AN EXAMPLE

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The object of this paper is to explain a method and the sequence of events leading to the identification of a solid medium suitable for cultivating certain anaerobes aerobically. It is based on a principle which, since it deals with colloidal chemistry, will be discussed in more detail elsewhere.

It is recognized that in order to initiate growth of anaerobes a negative Eh or oxidation-reduction potential in the medium is required. It is known that as mediums become more alkaline Eh becomes more negative. The negativity of medium exposed to the atmosphere is not as a rule sufficient for growth of anaerobes unless reducing substances are included in them. Shakes of some mediums are sufficiently reduced in their depths to support anaerobic growth especially if the medium has been well boiled before inoculation. Spray (1936) considers a semisolid medium highly appropriate for general use. He considers it important that only sufficient agar be added to the fluid base to check convection currents thus inhibiting aeration crediting Pringsheim (1910) with the first appreciation of this fact.

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Since variation in depth of growth of organisms in shake cultures is frequently observed it was felt advisable to take Eh and pH readings at various depths of unplanted shake mediums. The technique consisted in filing around the lower end of the test tube, encircling the scratch made by the file with a resistance wire and turning on the electric current until cracked. The lower end was knocked off and the medium cut at various measured depths as it presented itself from the cut end of the tube. The slices of medium were put into potentiometer beakers and electrodes inserted several millimeters for Eh and pH readings. The Beckman potentiometer with saturated KCl-calomel electrode for reference electrode was used. Each pH reading was constant but some Eh readings showed a slight but consistent drift (usually not greater than .03v.) which was not significant with reference to the general trend of results. Because of drift, readings were taken at ½, 1 and 1½ min. and 1 min. readings in terms of the reference electrode used in interpretations.

The medium used contained 2 gms. nutrient broth Difco and 7.5 gms. agar/1,000cc and was used as shakes in bacteriological test tubes. When the amount of NaOH (0.04 gms./1,000cc.) most routinely used giving a pH about 7.2 was added, Eh showed a slight decrease with depth (example, 0.1v at surface and 0.07 at 40 mm.) with slight if any variation in pH. More marked reduction occurred when more NaOH was added. A medium containing 0.48 gms. NaOH/1,000cc might show a surface Eh of 0.04 to 0.06v. decreasing to as much as —0.20 to —0.25v. at 52 mm. two days after it had been melted and solidified and a week after original preparation; the pH might vary from 8.72 at the surface to 9.27 at 56 mm.

In medium containing 0.48 gms. NaOH/1,000cc. anaerobic streptococci and the following Clostridia grew in 1-3 days: bifermentans, botulinum, histolyticum, multifermentans, oedematis-maligni, saccharobutyricum, sporogenes, tetani, welchii, vibrion septique. Growth was usually increased by 1 gm. dextrose/1,000cc. Since plants were in loopfuls from semisolid medium, growths were as individual, cottony, irregular or ball like colonies extending as a rule from 10-25 mm. to the bottom of 75-80 mm. shakes. When aerobes (E. coli communis, Staph. aureus, B. subtilis, Serratia marcescens, Ps. aeruginosa, etc.) were planted in this medium in sufficient number, a plate of growth about 2 mm. subsurface usually resulted, but when fewer organisms were added granules of growth extending as deep as 7 mm. sometimes resulted. Some aerobes produce a haze and very fine granules of growth extending deep into the medium while a few produced gas below a level of 20-30 mm. Differentiation of aerobes from anaerobes when both were planted

together was simple in mediums without sugar. With sugar, growth of anaerobes were so different that they usually could be recognized except where gas was produced. Growth of the aerobe usually reduced the medium below it so that the anaerobe grew higher in the shake.

When acid was added to the medium (0.036 HC1/1,000cc) the change in Eh with depth became slight to almost absent: the pH often remained constant.

While the trend of Eh changes is constant with depth in similar mediums they vary considerably. Depth and width of medium, time and preparation are factors. The decrease is often greater to 60 mm in 80 mm shakes and from this point shows a slight reversal. There is fluctuation at various depths of the same tube in many instances: some areas seem nodal and show no drift while others show considerable drift. It is possible that bands of growth of the same organism noted at various levels and occurring in unit time may be explained by a like Eh at the various depths.

Measurements on mediums containing no nutrient but only agar and the acid or alkali show that agar is probably more important than broth in the variation of Eh with depth, the other agencies modifying or poising its effect to a variable degree. The agar, however, does not support growth of the organisms studied, the added nutrient being essential.

When planted shakes of anaerobes are incubated under 60 lbs. oxygen for 4 days, instead of in the atmosphere, growth is usually less and 20 to 30 mm deeper in the medium. Eh readings on control tubes give a comparable change (increase) showing the effect of increased oxygen pressure on both depth of growth and Eh.

It must be borne in mind that Eh and pH readings while consistant and comparable do not necessarily indicate Eh and pH in the undisturbed shake placed in the atmosphere or under increased oxygen pressure.

Various aerobes grown at pH 7.2 (E. coli communis, Aerobacter aerogenes, etc.) in the atmosphere and under 60 lbs. oxygen (Williams, a, b, 1938:1939) produced Eh trends below their growths similar to those occurring in unplanted more alkaline mediums, but with an increase in acidity for a variable distance into the medium. Since increase in acidity tends to increase Eh an effort in addition must be demanded of organisms to reduce Eh. Under such conditions Eh and pH may counteract each other and increased acidity result in better permeation of oxygen. Such complex interrelationships must cause confusion with reference to relation of oxygen tension, pH and Eh.

Theoretically, since Eh is decreased from above downward in

mediums made up as shakes, by measuring Eh, position of growth of certain organisms should be predeterminable and on growing organisms they should be classifiable according to their Eh areas of growth. True, Eh is not the solution of the entire problem: the relationship is between oxygen tension, carbon dioxide tension, Eh and pH: but Eh and pH are measurements, so ultimately the problem is the significance of these measurements to oxygen tension, carbon dioxide tension, the medium and the organism. Basically fundamental with reference to living things is their medium-atmosphere relationship. (Williams, a, b, c, 1938:1939).

Other mediums are in the process of experimentation. The advantage of a medium of the percentage agar used are (a) semisolid consistency making it pipettable; (b) can be sectioned for Eh and pH measurements; (c) characteristic colonies can develop and hold their place; (d) can be planted to its depths and will close after the insertion; (e) depth and span of growth can be measured; (f) it is a base to which constituents can be added for study. Gelatin while showing variation is too sticky for satisfactory examination. Preliminary work shows variation in blood clots but little, if any, in silica gel.

Summary

A method of obtaining specimens at various levels in shake mediums for Eh and pH measurements is described.

The observation is made that there is a variation in Eh at various depths of unplanted medium: with increase in alkalinity Eh becomes more negative up to a certain point with depth: with increase in acidity this change becomes less. A frequently observed similar Eh at several levels suggests a possible explanation of bands of growth.

Theoretically, knowing the Eh at various depths in a medium, that area at which an organism will grow should be predeterminable: knowing the Eh over which an organism grows, the area of growth should measure the Eh in the respective medium.

Varying Eh in mediums containing only agar gives added proof of its dynamic nature in growth of microorganisms.

Increase in oxygen tension seems to lower the optimum Eh area of a medium for growth and likewise the growth.

Growth of anaerobes on the alkaline medium used is discussed. In many instances the alkalinity attained is well above the optimum given in various texts. The growth, however, is good. The good points of this medium are discussed in some detail.

The relation of aerobes to this problem is discussed.

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TYPHOID ANTIGENS IN RELATION TO AGGLUTINATION AND ACTIVE IMMUNIZATION

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The typhoid bacillus (*Eberthella typhi*) is known to contain several antigens or substances capable of producing antibodies or reacting with them in the test tube. One of these is contained in the flagella designated as H antigen by Weil and Felix (H derived from the German word, *Hauch*, meaning film) and a second in the body of the organism, the somatic antigen, designated as O (*Ohne hauch*). Additional antigen or antigens are apparently present on the surface of the organism. One of these is believed to be the Vi antigen of Felix and Pitt because it apparently bears a relationship to the virulence of the organism. Its importance to agglutination tests, however, is not established since no case of typhoid fever develops Vi antibody without being accompanied by either H or O agglutinin. It may, however, be of importance in relation to the preparation of typhoid vaccine for active immunization against the disease.

The H and O antigens differ in their specificity. There are at least twelve different members of the typhoid-paratyphoid group of bacilli capable of producing enteric fever. In general, the H Antigen is specific for the typhoid bacillus while the O antigen reacts with the agglutinin produced by other members of the group. For example, O typhoid antigen may be agglutinated by *B. paratyphosus B* agglutinin but H typhoid antigen never is. This does not mean that the O antigens of typhoid and paratyphoid bacilli B are identical, but that O antigen is composed of several different constituents and that typhoid and paratyphoid bacilli B may have one or more of these in common. Agglutination reactions occurring between these and other bacilli of the group are called "cross agglutination." To add to this confusion the H antigen of *B. typhosus* is specific but that in *B. paratyphosus B* may or may not be specific so that the latter is called diphasic. It is no wonder, therefore, that the agglutination test for the diagnosis of typhoid and other enteric fevers is not as simple as Gruber, Widal and other pioneer investigators thought it to be and requires that the tests and their interpretation be conducted with a great deal of care.

Under these conditions the agglutination test for typhoid fever

is now conducted with both H and O antigens. The former is best prepared of a smooth motile strain of *B. typhosus* while the latter should be prepared of a smooth non-motile culture like strain 0901.

The H antigen is prepared by cultivating the strain on beef-infusion agar in Blake bottles for 24 hours and suspending the growths in 0.2 per cent solution of formalin in normal saline solution. The suspension should be uniform or homogenous and neither too dense (which reduces the delicacy of the test) or too thin (which makes readings difficult or impossible). A suspension of about 2000 million per c.c. (corresponding to Nos. 6 or 7 of the barium sulphate nephelometer) is about right. After 72 hours in the refrigerator tests for sterility are made.

The O antigen is prepared by washing the growth from each Blake bottle in 10 c.c. of 0.5 per cent phenol in saline solution. The suspensions from several bottles are combined and one-half volume of absolute ethyl alcohol added slowly with constant stirring. It is allowed to remain at 35 to 37° C. for 18 hours after which the supernatant suspension is decanted, cultured for sterility and sufficiently diluted to give a turbidity equal to tubes Nos. 6 or 7 of the nephelometer. Further details of preparation are given in the American Public Health Association Year Book for 1935-1936, pages 144-158.

The tests are set up in six small test tubes and so arranged that each carries 0.5 c.c. of serum in dilutions ranging from 1:40 in No. 1 to 1:1280 in No. 6. To each tube and a control carrying 0.5 c.c. of saline solution is added 0.5 c.c. of H antigen which gives final dilutions of serum ranging from 1:80 to 1:2560. A duplicate test is conducted with O antigen and both sets placed in a water bath at 55° C. for 2 hours with refrigerator storage over night when the readings are made. These are graded from 1+ to a maximum of 4+ depending upon the clearness of the supernatant fluid. The highest dilution of serum producing a 3+ or 4+ agglutination constitutes the titre.

Agglutination with H antigen presents a loose fluffy sediment because the formalin-fixed flagella are prevented from coming in close contact with each other. The O antigen, however, is clumped in small dense granules which are broken up with difficulty.

If either antigen gives a titre of 1:80 or higher it is generally considered diagnostic of typhoid fever. Positive reactions with lower dilutions of serum are generally due to "normal" or "natural" agglutinins. The serum of a vaccinated individual, however, may also give a titre of 1:80 or higher in the absence of typhoid fever. The rise in H and O agglutinins, however, is not equal, since the H agglutinin predominates. In typhoid fever the O agglutinin appears first with the subsequent appearance of H. There exists,

therefore, a quantitative difference between the response of agglutinins to vaccination and to typhoid fever. In spite of vaccination an O antigen titre of 1:200 or higher indicates the presence of typhoid fever. Likewise, a high titre of H (like 1:1000) is usually diagnostic of the disease.

These antigens are also of importance in relation to the method used for the preparation of vaccine for active immunization against typhoid fever. It is generally agreed that vaccines of organisms in general are best prepared of young, smooth (S) colonies because these are always apt to be most virulent and to carry the antigens against which immunization is desirable. At the present time the Panama carrier strain of *B. typhosus* of the National Institute of Health is commonly employed and may be obtained from the Army Medical School, Washington, D. C. The vaccine is generally one carrying 1000 million per c.c. in 0.3 per cent tricresol in saline solution heated in a water bath at 53° C. for one hour and cultured for sterility.

Without doubt vaccines of living bacilli are probably more antigenic but are not employed although their subcutaneous or intracutaneous injection is apparently a safe procedure. As shown by Perry and Kolmer[1] in 1918, agglutinin and complement fixing antibody for *B. typhosus* was produced in rabbits in highest degree by the administration of vaccines of living and autolysed bacilli followed in order by chemically-killed, heat-killed and alcohol-sensitized sediment vaccines. Since then other investigators have shown that chemically-sterilized vaccines are sometimes superior to heat-killed vaccines in their capacity for producing antibodies.

The purpose of the present investigation was to determine whether or not living and chemically-killed typhoid bacilli were more active in the production of agglutinin in rabbits than heat-killed organisms and also to determine the capacity of H and O antigens of typhoid bacilli in the production of agglutinin as well as the undenatured antigen of Krueger, which apparently is largely composed of unaltered surface antigens.

Experimental

A single smooth motile strain of *B. typhosus* was employed for the preparation of all antigens in order to render these strictly comparative in their capacity for producing agglutinins in rabbits.

An antigen of *living* bacilli was prepared by suspending 48-hour growths on Blake bottles of agar in sterile saline solution and diluting with saline to give approximately 2000 million per c.c.

[1] Perry, M. W. and Kolmer, J. A.: A Study of the Immunizing Properties of Bacterial Vaccines Prepared after Various Methods. Jour. Immunology, *3*, 247-259, 1918.

An *H* or *flagellar antigen* was prepared by suspending 48-hour growths on Blake bottles of agar in 0.2 per cent solution of formalin in saline solution and diluting with the same to secure a suspension of about 2000 million per c.c.

An *O* or *somatic* antigen was prepared by treating the saline suspension of 48-hour Blake bottle agar cultures with alcohol as previously described. The antigen was diluted to equal in density the suspensions of living and H antigens.

A *phenolized* antigen was prepared by suspending 48-hour Blake bottle agar cultures in 0.5 per cent phenol in saline solution and diluting with the same to give a suspension of approximately 2000 million per c.c.

A *heat-killed* antigen was prepared by suspending 48-hour Blake bottle agar cultures in saline with dilution to about 2000 million per c.c. The suspension was then heated in a water bath at 60° C. for one hour and preserved with phenol in 0.5 per cent concentration.

An *undenatured* antigen was prepared after a modification of the Krueger method by cultivating the strain on Blake bottles of agar for 48 hours. Each growth was removed with phenolized-saline solution to give very dense suspensions which were mixed and shaken mechanically with glass beads for six hours. The suspension was then placed in a refrigerator over night and diluted with saline solution to give about 2000 million per c.c. This suspension was then passed through a fine sterile Berkefeld filter and the crystal-clear filtrate used as antigen for the immunization of rabbits.

Two rabbits were immunized with each antigen receiving 1 c.c. of a 1:10 dilution per kilogram of weight by subcutaneous injection every 3 to 4 days for a total of four injections. This dose corresponded to approximately 200 million bacilli or its equivalent in the undenatured antigen per kilogram of weight.

Preliminary macroscopic agglutination tests were conducted with the sera of all rabbits before the first injection of vaccine. All gave negative reactions in final dilutions of serum ranging from 1:10 to 1:320.

Four days after the last injection of vaccine each rabbit was bled from the heart and macroscopic agglutination tests conducted with each serum against the living, H, O, phenolized and heat-killed antigens. The undenatured antigen of course could not be employed for agglutination tests since the filtrate was crystal-clear but the sera of two rabbits immunized with this vaccine were tested against all of the other antigens.

These tests were conducted by placing 0.5 c.c. of dilutions of serum varying from 1:50 to 1:10000 in small test tubes. To each was added 0.5 c.c. of antigen, which made the final dilutions 1:100

to 1:20000. A control on each antigen was included set up with 0.5 c.c. of saline solution and 0.5 c.c. of antigen. The contents of each tube were gently mixed and the tubes placed in a water bath for 2 hours at 55° C. followed by storage in a refrigerator at about 6° C. until next day when the readings were made.

Results:—The results summarized in Table I show the highest final dilutions of each serum giving definite agglutination (+ to++) with its homologous and other antigens.

Table I.—AGGLUTININ TITRES WITH VARIOUS ANTIGENS

Rabbit No.	Vaccine used for Immunization*	Agglutinin Titres with Following Antigens***				
		Living	H (formalin-sterilized)	O (alcohol-sterilized)	Phenol-sterilized	Heat-sterilized
1	Living	1:12000	1:8000	1:20	1:8000	1:8000
2	"	1:5000	1:3000	1:20	1:3000	1:4000
3	H(formalized)	1:5000	1:4000	1:20	1:3000	1:3000
4	" "	1:2000	1:1600	1:20	1:1200	1:1200
5	O(alcoholic)	1:1600	1:1600	not in 1:20	1:1200	1:1600
6	" "	1:1200	1:800	1:20	1:800	1:1600
7	Phenolized	1:10000	1:8000	not in 1:20	1:6000	1:6000
8	"	1:1800	1:1400	not in 1:20	1:1800	1:3200
9	Heat-killed	1:10000	1:10000	1:20	1:6000	1:12000
10	" "	1:2000	1:1600	1:20	1:2000	1:2000
11	Undenatured**	1:1200	1:1200	not in 1:20	1:1000	1:2000
12	"	1:800	1:400	not in 1:20	1:400	1:1200

* 200 million per kilogram subcutaneously every 3 to 4 days for four injections.

** 1 c.c. of 1:10 dilution per kilogram subcutaneously every 3 to 4 days for four injections.

*** Tests conducted 4 days after last injection of vaccines; highest final dilutions of sera giving positive (+ to ++) macroscopic agglutination.

As previously stated, two rabbits were immunized with each antigen administered subcutaneously in the same dose per kilogram

of weight. But, as shown in Table I, the agglutinin production varied in the case of each set of two animals with each of the respective antigens, showing that rabbits present individual variations in agglutinin production requiring conservatism and care in the drawing of deductions and conclusions.

One striking result, however, has been the fact that all six of the vaccines produced remarkably small amounts of O agglutinin since the titres were so low for O antigen (about 1:20)* Even the two rabbits (Nos. 5 and 6) immunized with O vaccine produced only small amounts of agglutinin (not in 1:20 and 1:20 respectively) for O antigen. This is in conformity with the observation that in typhoid fever and after active immunization with typhoid vaccine, agglutinin for the somatic or O antigen of *B. typhosus* does not reach a high degree of production. However, the O vaccine produced agglutinin for antigens of living, formalin-sterilized (H), phenol-sterilized and heat-sterilized antigens, indicating that in the preparation of O antigen by extraction of the motile strain employed with alcohol apparently other antigens and particularly H or flagellar antigen, was included to account for the production of agglutinin for these antigens.

The predominance of flagellar antigen was also indicated by the fact that the agglutination observed with the antigens of living, formalin-sterilized (H) and phenol-sterilized antigens was largely of the loose fluffy type characteristic of flagellar agglutination. Curiously enough, however, the agglutination observed with the heat-killed antigen was largely of the granular or O type.

In general terms most agglutinin was produced by the vaccine of living typhoid bacilli followed in close order by the phenol- and heat-sterilized vaccines. The formalin-sterilized vaccine came next in agglutinin production while the alcohol-sterilized and undenatured vaccines produced the least agglutinin. Insofar as the latter is concerned this may have been due to the fact that this vaccine contained smaller amounts of antigen per cubic centimeter than the other antigens because of Berkefeld filtration, but the results have shown that it apparently contained antigens derived from the surface of the bacilli as well as most likely some from the flagella, and even from the bodies of the organisms as the result of autolytic changes occurring in the course of its preparation.

In general terms it would appear, however, that the results of this investigation have shown that in rabbits, at least, most agglutinin and presumably other antibodies as well, are produced by a vaccine

* This may have been due to the presence of Vi antigen which inhibits the production of 0 agglutinin. The strain was of such virulence that 0.1 c.c. of a 1:10 dilution of a 24-hour broth culture was fatal for white mice by intraperitoneal inoculation.

of living typhoid bacilli. Such, however, is considered in the United States at least too dangerous for administration to human beings in vaccination or active immunization against typhoid fever. Apparently chemically-sterilized vaccines rank next in antigenic activity and especially vaccine sterilized with phenol, the formalin-sterilized vaccine giving closely similar results. Heat-sterilized vaccine ranked next in antigenic activity and was very close to the chemically-killed vaccines in the production of agglutinin. An alcoholic extract of typhoid bacilli (the O antigen) was much less active than these in the production of antibody as likewise the undenatured vaccine, although the results observed with the latter may have been due to factors concerned in its preparation as previously discussed.

Summary

1. *Bacillus typhosus* (*Eberthella typhi*) contains several antigens of importance in relation to the serum diagnosis of the enteric fevers and in relation to vaccination or active immunization against typhoid fever.
2. Of these the H antigen derived from the flagella of motile strains and the O antigen derived from the bodies of non-motile strains by extraction with alcohol are best known and of most importance. In addition, a Vi antigen may be contained in freshly isolated virulent strains as well as surface antigens.
3. The H antigen of *B. typhosus* is specific for typhoid bacilli while the O antigen is shared by other members of the enteric group of organisms and especially by *B. paratyphosus B* (*Salmonella schottmülleri*). In other words, H antigen of *B. typhosus* is specific while its O antigen is group specific and responsible for cross-agglutination reactions with closely related organisms.
4. In the serum diagnosis of typhoid fever by the agglutination test both H and O antigens should be employed and especially if an individual suspected of having typhoid fever has been previously immunized with typhoid vaccine.
5. In typhoid fever agglutinin for O antigen usually appears first but ultimately agglutinin for H antigen predominates. In spite of vaccination a titre of 1:200 or higher with O antigen indicates the presence of typhoid fever as likewise a titre of 1:1000 or higher with H antigen.
6. Rabbits were given a subcutaneous injection every three or four days for a total of four doses of approximately 200 million typhoid bacilli per kilogram of weight of living, formalin-sterilized (H), alcohol-sterilized (O), phenol-sterilized and heat-sterilized vaccines as well as the equivalent of this dose of

undenatured vaccine. All of the vaccines were prepared of a single motile strain.

7. The animals were bled four days after the last dose and the agglutinin content of each serum titrated against each of five antigens (living, H, O, phenol- and heat-sterilized).
8. The sera of all of the rabbits immunized with the six vaccines contained very small amounts of agglutinin for O antigen including two which were immunized with this vaccine. The O vaccine, however, produced relatively large amounts of agglutinin for the antigens of living, formalin, phenol and heat-sterilized antigens.
9. In general terms the maximum of agglutinin production was observed in rabbits after immunization with a vaccine of living bacilli followed in close order by phenol-sterilized, heat-sterilized and formalin-sterilized vaccines. The alcohol-sterilized (O) and undenatured vaccines gave the lowest production of agglutinin but in the case of the latter this may have been due to technical factors involved in the preparation of the vaccine.

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A NEW INDEX OF RESPIRATORY EFFICIENCY*

By ARTHUR T. BRICE, B.A., M.T.

A science is defined as a mass of observed data systematically classified and correlated so as to be brought under general laws. It is my conviction that during the youth of our profession we will do well to be guided largely by such fundamental definitions, and also that the compilation of the mass of observed data is a function very particularly our own in the medical field. I am, therefore, going to describe to you simply the tool with which I am at present working to compile a mass of observed data.

This new index of respiratory efficiency, as with so many other discoveries, was originated by two different men working independently though simultaneously—Dr. Edwin E. Ziegler, whose first paper appeared in the Journal of Aviation Medicine of December, 1933; and an Englishman, Dr. Alan Moncrieff, whose monograph on the subject was published by The British Medical Research Council in October, 1934. The index, as originated by these two, is reported in somewhat different manner, though the procedures by which it is arrived at are essentially the same, and the index of one may be readily transposed to that of the other. It was my fortune to learn of this index and subsequently to work under Dr. Ziegler's supervision for the greater part of three years. I assisted him with the statistical analysis of some of his earliest data, and I am sure that I know so well the history of the evolution of this test that I can describe it for you most readily by placing you in Dr. Ziegler's position and showing how any one of you might have originated this interesting procedure. Assume then that you are running the routine basals at some hospital; for example the Veterans' Hospital, Boise, Idaho. You live in the hospital which is situated in a comparatively small community. You are removed from the attractions and distractions of the life of a large city. You are able to think not superficially but profoundly about the things that you are doing and about the significance of your work. You observe a series of respiratory graphs passing through your hands, and you begin to wonder why it is that all this respiratory data recorded by the breathing of patients is used only as an index of the functioning of the patients' thyroid gland. Surely respiration is also a function of medical importance. You look at these respiratory graphs more

* Paper delivered at the Sixth Annual Convention of the American Society of Medical Technologists, San Francisco, California, June 15th, 1938.

closely; and I am going to show you now on the screen examples of what you most likely might have seen.

Take for example a respiratory graph such as this (No. 1).† The most noticeable feature is the fact that the individual respirations are very irregular as to depth or amplitude, and you might be caused to wonder if this is a normal condition and to examine other graphs to see if the same feature appeared. The next graph such as this (No. 2) might show quite marked uniformity of the respiratory amplitude or depth over the entire period of the test. In our next (No. 3) we might note a very small amplitude or depth of respiration and also an irregularity of the rate of respiration, the number of respirations in the 3rd minute being 32 tapering off to an average of 22 maintained approximately for the last 8 minutes. This brings into our minds a second factor which we can measure on these graphs. Our first, the amplitude of the respiration; our second, the rate of respiration. Compare this graph with our next (No. 4) which shows a very marked difference. The amplitude is very large, 1900 c.c. Surely these individual differences have some significance as to the condition or efficiency of the respiratory function of the patient. We have observed how different in some respect each one may be. We might see a graph such as that shown on our next slide, (No. 5). This patient, while his rate of respiration and also his depth of respiration was quite regular, still showed an unusual characteristic in that his breathing was evidently at different levels of his lung capacity, this level varying in a markedly cyclic manner.

Now these factors, namely the amplitude of respiration and the rate of respiration which vary from patient to patient, we can measure by means of these graphs. There is another factor of respiration which we do measure in each one of these graphs for the determination of our basal metabolic index, and that is the amount of oxygen consumed per minute, determined as you all know by the slope of the graph line. Let us take two graphs showing about the same values of oxygen consumed per minute (No. 6) and consider what use we may make of this measurement and also the two other measurements which I have mentioned. There is little need for me to describe how the oxygen consumed per minute is determined. This is all laid down in the instructions for the determination of the basal metabolic rate by means of whatever instrument or respiratory calorimeter you may be using. The average respiratory rate per minute is simply determined by counting the

† As a result of the excessive cost of reproducing completely the large series of graphs shown with this paper the figures with the exception of No. 14 are omitted. The author will be glad to send photographic reproductions to complete the series to anyone who is interested and will write to him requesting them.

number of respirations shown in the space representing one minute on the chart, or as I usually do, count the total number of respirations registered on the entire graph for that patient and divide by the number of minutes of the test. By this method it appears that the two patients whose graphs are shown had average respiratory rates of 15 for the patient whose graph is above, and 25 for the patient whose graph appears below. The amplitude of respiration or the mean respiratory amplitude is most readily calculated graphically by drawing the line joining the greatest number of the ends of the inspirations as shown on these two graphs and measuring the mean distance between them. This can be most readily converted into terms of cubic centimeters by making a little ruler from the data supplied you with each of your machines which converts vertical distance on the chart into terms of cubic centimeters in the oxygen bell of the machine. Thus having drawn the top and bottom lines, measure and convert the respiratory amplitude at the beginning and ending of each test and take the average of the measurements made as the mean respiratory amplitude. For the graphs shown these values are 400 and 230 cubic centimeters respectively. Let us compare two more graphs in the same manner (No. 7). These two patients also show close values of oxygen consumed per minute, 165 and 160 c.c. The upper graph shows a comparatively low average respiratory rate per minute of 6, and a comparatively high mean respiratory amplitude of 600 c.c. The lower graph shows a comparatively higher rate per minute of 15, and a comparatively lower mean respiratory amplitude of 250 c.c. of oxygen.

Having pondered the subject up to such a point, one might wonder "how can we use these factors to show anything objectively about the respiratory efficiency of the patient?" I believe that some of you may have already sensed the calculation which suggests itself. How much oxygen did these two patients have to handle through their lungs in order to get the 160 or 165 c.c. per minute which they consumed? If we should add up the depths or amplitudes of each inspiration over a period of one minute we would know this quantity—namely the oxygen per minute respired. Or for a more reliable calculation taking the whole period of the test into consideration, if we should multiply the average respiratory rate by the mean respiratory amplitude, we should know this same quantity—the oxygen per minute respired. It is obvious that a patient who has to handle through his lungs a large quantity of oxygen in order to get for consumption a certain amount has a lower respiratory efficiency than one who only handles through his lungs a small quantity of oxygen in order to get for consumption the same amount. The respiratory efficiency or the oxygen absorb-

ing power index is thus simply a matter of the proportion between the oxygen per minute consumed and the oxygen per minute respired, and by its calculation we can show something objectively about the respiration function of the patient. I will show you this formu'a on the screen and if you will make note of it, or if you will get it from the Journal in which I trust it will appear subsequently, you can join me in this work of the compilation of a mass of observed data.

(Slide No. 8). Oxygen consumed per minute we will represent by O_2C; average respiratory rate per minute by ARR; mean respiratory amplitude by MRA; and oxygen respired per minute equals ARR x MRA. The respiratory efficiency is the relation of the oxygen consumed per minute to the oxygen respired per minute or the oxygen absorbing power index as we will call it equals the oxygen consumed per minute divided by the oxygen respired per minute, that is in terms of symbols, O_2API equals O_2C divided by ARR x MRA.

Let us apply this formula to a number of charts and see what it reveals. First, (No. 9) here is a chart showing an O_2C of 280, an ARR of 12, an MRA of 400 and a value for oxygen respired of 12 x 400 equals 4800. The absorbing power index or the per cent of the amount respired that is consumed is 280 divided by 4800 equals 5.6%. Again (No. 10) oxygen consumed per minute, 232; average respiratory rate, 16; mean respiratory amplitude, 425; oxygen respired, 425 x 16 equals 6800; percentage of the oxygen respired that was consumed, 232 divided by 6800 equals 3.4% the oxygen absorbing power index. Again (No. 11) O_2C, 157; ARR, 12; MRA, 550; oxygen respired per minute, 12 x 550 equals 6600; relation of oxygen consumed to oxygen respired, 157 divided by 6600 equals 2.4% the oxygen absorbing power index. Again (No. 12) O_2C equals 272; ARR equals 9.7; MRA equals 500; oxygen respired per m'nute 9.7 x 500 equals 4850 c.c.; absorbing power index 272 divided by 4850 equals 5.6%. Again (No. 13) oxygen consumed per minute 225; average respiratory rate 20; mean respiratory amplitude, 400; oxygen respired per minute 20 x 400 equals 8000; absorbing power index 225 divided by 8000 equals 2.8%.

I will show you again our formula to fix it in your minds, and then let us look at some comparative values of this index.

Oxygen consumed per minute we will represent by O_2C; average respiratory rate per minute by ARR; mean respiratory amplitude by MRA; and oxygen respired per minute equals ARR x MRA. The respiratory efficiency is the relation of the oxygen consumed per minute to the oxygen respired per minute or the oxygen absorbing power index as we will call it equals the oxygen consumed per minute divided by the oxygen respired per minute, that is in terms

of symbols, O_2API equals O_2C divided by ARR x MRA.

(Slide No. 14). We are now again looking at two graphs from two different patients. The one above shows very deep breathing at a low rate and his index calculates 1.8%. It is plain to see that his efficiency was low. He respired a large amount for the amount consumed. The patient whose graph is below gave an index of 3.3%. His respiratory rate was higher than that of the patient shown above, but the amplitude of each respiration was markedly lower resulting in a higher efficiency for this patient. Let us look at two more (Slide No. 15). These two patients showed identical values of 215 c.c. consumed per minute, yet because the upper patient's respiration was more rapid and deep, his efficiency was lower 1.2% than that of the patient below whose respiratory rate was lower and whose amplitude was lower and whose index was 4.8%.

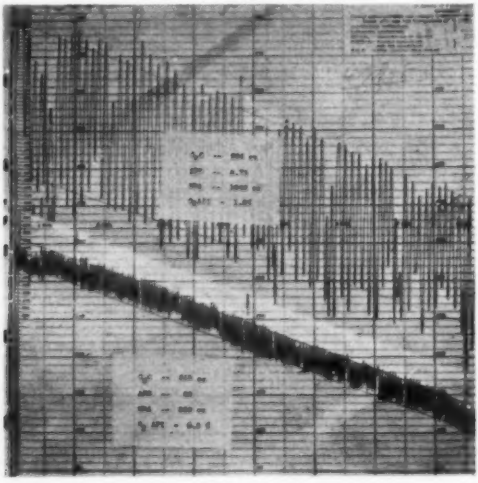

Figure No. 14

Two more charts we will look at (Slide No. 16) again showing identical values of 192 c.c. consumed per minute and also identical values of mean respiratory amplitude of 300 c.c., yet because the respiratory rate of the patient shown above was only 13 per minute compared to 19 per minute for the patient shown below, the efficiency indicated by the upper graph is 4.9% compared to 3.3% by the graph below.

These illustrations have demonstrated to you how these absorbing power indexes may be calculated from the average run of charts that you will obtain. Graphs will be met with which simply cannot be calculated by means of the instruments at present avail-

able, for example (No. 17) this chart which shows such great irregularity as to amplitude that we simply cannot accurately draw a bottom line and measure the mean respiratory amplitude, nor can we on this one (No. 18). If we could measure each of these inspirations and add them all up, we could obtain a figure for the oxygen respired per minute, but this would be a long, time-consuming and tedious operation of doubtful value as to the amount of information obtained from the energy expended. We may be liberated from such tedious occupation in connection with such cases by the advent of a new machine, for I understand that Dr. Ziegler is working in collaboration with the manufacturers of one of the well-known types of respiratory calorimeters or basal machines to place on these instruments a gadget corresponding to the mileage indicator on your automobile, which will automatically add up these individual different respirations while the patient is breathing and show on a dial at the end of the test, the total value of the oxygen respired.

With regard to the significance of these indices to the pathologists, there is little that can be said at the present time. Ziegler believes that a high index signifies a respiratory capacity of value in aviators and other occupations requiring high respiratory efficiency and in athletics, although to my knowledge this conclusion is as yet not supported by any mass of observed data. Indices calculated for groups of patients free from obvious conditions which might affect respiration indicate that ⅔ of such patients will show values between 3 and 4.6%. Moncreiff rates 3% as a critical value and considers that values lower than this represent some definite respiratory functional failure. Of course in routine work our only opportunity to collect a mass of data for the purpose of elucidating the pathology involved comes from those patients suspected of thyroid disfunction. It has been my opportunity to date to take this index on only one case of type other than this—a terminal uremia (Slide No. 20). It showed at the time a blood non-orotein nitrogen value of 333 mg% and creatinine of 6.6 mg% and the oxygen absorbing power index the very low value of 1.9%. Whether this value represented a condition secondary to the kidney condition; or whether not inconceivably the kidney condition originated secondarily to a low absorbing power index; or whether there was no true correlation between the two conditions and their coincidence in the same patient was purely a matter of chance, I can not say. At the present time the answer to such questions awaits the accumulation of a mass of observed data and its systematic classification and correlation to ascertain whether any general laws may have been followed or are disclosed. All that the index represents to our doctors to whom we report it is just another

"dab" to those pictures which we are forever painting of a patient's underlying condition.

Therefore in conclusion let me repeat a thought which is not a new thought, that therapy is an art, and as all know an art requires above all else inspiration. The smile of health on the face of Youth, the cultured tranquility of Age—these must be very vital values in the lives of our doctors, though not so necessary in ours. The wonder of nature and of order her first law; the little questions that we sometimes may ask and that sometimes she may answer; the satisfaction of action based on exact quantitative measurement; these things are the vital values in our lives. Imagination must be allowed us, too, it is true. Let us train it along the line that Banting, the originator of insulin, speaks of in one of his papers as the "constructive association of ideas"; but let us remember that the columns of our tabulated records and reports may not be totaled up until after we, as individuals, have gone and may make but a negative then. Let us subscribe to the thought of that Spanish poet of the 16th century Fray Luis De Leon who wrote: "What a peaceful life is that of the one who flees from the noise of the world; and follows the hidden paths through which have gone those few wise ones there have been upon the earth."

VALUE OF EXACT BACTERIOLOGICAL DETERMINATIONS*

By ANN SNOW, M.T.

Department of Bacteriology, University of Arkansas School of Medicine, Little Rock, Arkansas

The existence of living beings too small to be seen with the naked eye, was inferred by philosophers and physicians of ancient Greece. Some of these thinkers advanced theories as to disease causation which are quite similar to those included in the modern germ theory. Bacteriology as a separate science, however, is of recent origin. Practically all the knowledge of the subject has been obtained since 1860, with the major portion of advancements dating from about 1890.

The first ocular evidence that micro-organisms did exist was brought forth by the Dutch microscopist, Anton van Leevwenhoek during the seventeenth century. His interesting discovery was however, practically ignored for almost a century. In 1786 the Danish Zoologist, O. F. Muller, in the face of many obstacles, succeeded in making discoveries which added much to the knowledge concerning bacteria. During the next half century several investigators made advancement in the study of organisms but their work seems to be completely obscured by the work of Pasteur. About this same time the work of Robert Koch must be credited with establishing bacteriology on the basis of an independent biologic science. He succeeded in proving the relationship of bacteria to disease, and invented solid culture media (1).

Bacteriology is a science of tremendous importance because of its many practical applications. The early contributions of bacteriology are still with us. Consider for example the contributions of Lord Lister, in the field of aseptic surgery; the importance of the discovery of tetanus and diphtheria antitoxin. Consider also, the great advantage of knowing the various kinds of bacteria involved in disease processes. When these discoveries were made, they were received with loud acclaim. Today however, because of the fact that these discoveries are commonplace in medicine, doctors and laymen alike accept them as such and their true significance tends to become obscured.

Because of this, it naturally follows that, in some quarters, bacteriology is looked upon as a science of little practical value in the medical field. However, if we wish to gain a true perspective

* *Read before the American Society of Medical Technologists, San Francisco, Calif., June, 1938.*

of the role of modern bacteriology in medicine and surgery, let us just consider what would happen if all bacteriological determinations were abandoned. What would happen to the diagnosis of typhoid fever? What would happen to the diagnosis of bacillary dysentery; the diagnosis of diphtheria; gas gangrene; tuberculosis; tularemia; undulant fever, etc. What would happen in the practice of preventive medicine in many of the infectious diseases if patients should be released from isolation without securing release cultures?

From this it becomes apparent, I think you will agree, that bacteriology is a science of varied applications.

1. It aids the physician and surgeon in diagnosis of disease by telling them which parasite it is that they must combat.
2. It gives them a clue as to the pathological process.
3. It gives them a basis for treatment and prognosis.
4. Bacteriology furnishes in a number of instances a direct method of preventing disease.
5. Last but not least, we should not forget the applications of bacteriology to sanitary engineering, to the dairy industry, to the study of soil fertility, and its application to various industries.

When we consider the conspicuous place that becteriology holds in the medical field, and the devastating effect that bacteria have upon the tissues of the human body, it behooves the technologist to put forth every effort possible to assist in diagnosis. Of course it takes time, intelligent effort and patience to work out the species of organisms but when we realize how much this information may mean to the doctors as well as to the patient, it is well worth the extra effort.

The foregoing facts are well known to all laboratory workers. However, in spite of this it is also well known to most of you that there are many laboratories, especially smaller ones, which are negligent in working out bacteriological problems with sufficient precision. The methods by which this work is being done may be classed as follows:

1. Those who rely on smears of all kinds stained with methylene blue or other simple stains.
2. Those who rely on smears but use the Gram stain.
3. Those, who in addition to stains use the least amount and kinds of culture media compatible with their conscience.
4. Those who make full use of the knowledge and facilities provided by modern methods of bacteriology.

The burden of proof is on the members of the first three groups, if they claim that their methods are adequate. When a specimen for bacteriological examination is sent to the laboratory, the physician is expecting from the worker a careful, thorough and conscientious report. It is needless to say how many mistakes can be made by

merely making a smear, staining it hurriedly and turning out the report. No doubt the correct diagnosis is occasionally hit, as the laws of chance would take care of that but many are the cases which are not so fortunate. Very little information is given to the physician when a Gram negative rod or Gram positive bacillus is reported, since there are numerous species of both in existence. To attempt the diagnosis of bacteria by the slide method alone is to play havoc with the science of bacteriology and is a step backward.

In some laboratories may be found only a few bottles of material which is used for making the most simple and ordinary media. Even though plain agar and broth are the fundamental basis of all media, it must be remembered that bacteria like people, display quite a varied lot of peculiarities. Some not only require a special medium to satisfy their fastidious tastes but also a certain amount of coaxing on the part of the worker is necessary in order to get the best results.

Let us take for example, a specimen of urine gotten by cystoscopy. It is planted in plain broth or on plain agar. A growth is obtained which may show Gram negative bacilli. Without further determinations, the report goes in as Bacillus coli. Just how near correct is the report and what difference does it make to the patient?

A very interesting report is given by Braasch (2) on his observation of two hundred cases of kidney infection at the Mayo Clinic. Eschericha coli was present in 42 per cent of the cases. Aerobacter aerogenes, belonging to the same tribe and very similar in cultural characteristics, was found in 13 per cent of the number. While this organism responds to treatment as does E. coli, it is more tenacious and more resistant. Proteus, with an incidence of 3 per cent, was not only an indolent invader causing chronic infection, but went even farther by destroying the kidney or causing malignant formation of stones. However, it was found that Proteus could be eradicated if diagnosis was made in the early stages of infection. But could these diagnoses be made by looking at smears?

Again, may we consider some material from a lesion which is sent to the laboratory. A smear is made and a Gram positive bacillus is found and without animal inoculation for confirmation, a diagnosis of Bacillus anthracis is made. The worker goes merrily on his way quite confident that the organism is not one of the numerous species of the same genus. It is true that the patient may get along just as well but from a scientific point of view this kind of worker is violating scientific traditions.

All humanity is indebted to the scientists who have worked so diligently to combat that stormy disease, which is reckoned as one of the foremost causes of death today, pneumonia. To Neufeld goes the credit of giving us a method for determining specific types of

pneumococci. In its accuracy, simplicity, and rapidity, it has been the means of reducing the mortality in this disease. The specific treatment with antipneumococci serum depends entirely upon the rapid and accurate determination of the type. All laboratories should realize the importance of keeping on hand a supply of typing serum, and be ready to do their part in combating pneumonia (3).

Associated with pneumonia is the condition of empyema, frequent causes of which are the pneumococci and streptococci. Here we again find it necessary to make an accurate differentiation. Because of the difference in the pathology of the local process caused by these two organisms, the surgeon is entitled to know which organism is involved so that he can be guided accordingly in his treatment of the patient.

The value of careful blood culture study is unlimited. Although we cannot always be held responsible for false negatives, we are liable for erroneous reports which might mislead the physician. So often the organisms found are strange contaminants or represent a transient bacteremia which has no relation to the disease in question. Unless the species of organism is carefully worked out, we cannot in truth say, what micro-organism is giving rise to the septicemia or bacteremia. A Gram negative rod in the blood does not support a diagnosis of typhoid fever until it has been proven that the organism in question is the typhoid bacillus. Diphtheroid bacilli may sometimes resemble streptococci and unless the differentiation is made, the true nature of the organism is not revealed.

Some workers have found the cough plate method of great practical value in the diagnosis of whooping cough. Many abortive and atypical cases occur and these are believed to play an important role in maintaining and spreading the disease. While this method is not in general use in this country, it could do much if put into practice, by preventing the spread of a disease which annually is the cause of many deaths among chilldren (4).

While we might go on indefinitely enumerating the possibilities of errors and the value of careful detail in making bacteriological determinations, we would in each case come to the ultimate decision that bacteriology as a science should not be treated as the stepchild of the laboratory.

In conclusion it might be said that technologists should unite with the large army of workers in the field of bacteriology who are doing great things toward the advancement of this science, in order that their achievements may be perpetuated and utilized instead of being disregarded. Regardless of the amount of work we do, our aim should always be to keep bacteriology strictly on a scientific

basis. Anything less than that is folly, and is not in keeping with the true spirit of science.

Prepared under the supervision of J. G. Wahlin, Ph.D., Professor of Bacteriology, University of Arkansas School of Medicine.

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2. Braasch, W. F. Clinical Data Concerning Chronic Pyelonephritis. The Journal of Urology, 39:1-33, Jan., 1938.
3. Pneumonia. A Public Health Problem. The Health Officer. 2: 197-200, Oct., 1937.
4. Kristensen, B. Occurrence of the Bordet-Gengou Bacillus. J.A.M.A., 101:204, July, 1933.

BOOK REVIEW

LABORATORY MANUAL OF HEMATOLOGIC TECHNIC, by Regena Cook Beck, M.A., M.D., Formerly Instructor in Pathology and Bacteriology at George Washington University Medical School; Head of the Department of Bacteriology, William and Mary College Extension; Pathologist to Stuart Circle Hospital and Director of the Stuart Circle Hospital School of Medical Technology, Richmond, Va. With a Foreword by Frank W. Konzelmann, M.D., Professor of Clinical Pathology, Temple University, Philadelphia. 389 pages with 79 illustrations. Philadelphia and London: W. B. Saunders Company, 1938. Cloth, $4.00 net.

This noteworthy manual will be highly instructive to students and informative to clinicians, pathologists and others. The author considers hematology the study "of all the tissues and processes by which the various cellular elements of the blood are formed, destroyed or eliminated." Hence not only are the technics for study of the cellular elements considered but special studies are given such as test for heterophile antibodies, bilirubinemia, sedimentation rate, fragility test, bone marrow studies, etc. In Part V on special blood pathology chapters are devoted to diseases in which erythrocytes and leucocytes are chiefly affected, animal parasites in the blood, blood findings in infants and children and the effect of chemicals, radioactive substances and splenectomy on the blood picture. The lucid interpretations of the various blood pictures and tests constitute by no means the least important part of this volume. The author has drawn freely from authoritative literature as well as her own extensive experience as a teacher of laboratory technicians during which more than 350,000 tests were done under the direction. The questions at the end of each chapter are most helpful to students in emphasizing the important points.

NEWS AND ANNOUNCEMENTS

REGISTRY OF MEDICAL TECHNOLOGISTS
OF THE
AMERICAN SOCIETY OF CLINICAL PATHOLOGISTS

The 1939 annual meeting of the Board of Registry of the American Society of Clinical Pathologists will be held in St. Louis, May 11-14, during the convention of the parent organization, the American Society of Clinical Pathologists.

The April, 1939, examination class had four hundred and thirty-seven prospective applicants. One hundred and thirty-four competent Clinical Pathologists conducted the practical and written examinations on April 28th, in one hundred and twenty-one cities throughout the United States, Canada, Puerto Rico and Hawaii.

The next semi-annual examination will be conducted by the Registry of Medical Technologists in the fall of 1939, applications for which should be on file by September 1, 1939, the closing date.

NATIONAL

Sisters attending the St. Louis meeting, Please Note: "The Sisters' Reservation and Entertainment Committee held a meeting in St. Louis, Mo., the first week in January. The members of the committee were able to secure twenty-five private and semi-private rooms in Sisters' Institution to be used for members and guest Sisters attending the National Convention, to be held on May 18-20, 1939. Reservations can be had by addressing the members of the committee:

Sister Mary Irmena Olds, S.S.M., Chairman, St. Mary's Hospital, Kansas City, Missouri.

Sister Mary Francis McRory, S.S.M., St. Mary's Infirmary, St. Louis, Missouri.

Sister Mary Heriberta Schedel, S.S.M., St. Mary's Hospital, St. Louis, Missouri.

Massachusetts Institute of Technology, Cambridge, Mass., Department of Biology and Public Health, is offering, this summer, a course in Public Health Bacteriological Methods. The course will be given Mornings (9-12) and Afternoons (1-4) from July 3rd to July 21st. For information write to John W. Williams, M.D., care of the above address.

Missouri

A local organization has been formed at St. Louis. Their official title is the Society of Medical Technologists of Greater St. Louis. It includes, however, Granite City, East St. Louis, and Belleville of Illinois. At their initial meeting, they elected the following officers: President, Sister M. Heriberta (Schedel), M.T.; Secretary and Treasurer, Roberta Miller, M.T.; Chairman of the Program Committee, Sister M. Bernado (Mulligan), M.T.; Chairman of the Executive Committee, Olive Stone, M.T.

Also, there is a state society in Missouri of which Olive Stone, M.T., is the President.

American Society of Medical Technologists

Program of the Seventh Annual

Convention

Headquarters

HOTEL JEFFERSON
Twelfth and Locust Streets
St. Louis, Mo.

MAY 18, 19, 20, 1939

Statue of St. Louis

COMMITTEE CHAIRMEN

Program—GLADYS ECHFELDT, Newton Hospital, Newton, N. J.

Scientific Exhibits—HENRIETTA LYLE, St. Joseph's Hospital, Lancaster, Pa.

Entertainment—MARIAN A. BAKER, Taylor Laboratory, Lufkin, Texas.

Sisters Reservation and Entertainment—SISTER MARY IRMENA OLDS, 2800 Main St., Kansas City, Mo.

Local Arrangements—CATHERINE SMITH, 3619 Paris Ave., St. Louis, Mo.

Reception and Registration—MARGARET J. BURGESS, Pana, Ill.

REGISTRATION—Members and guests are requested to register upon arrival. Registration, Hotel Jefferson, 12th at Locust.

SISTERS—Please write to Sister Mary Irmena Olds, S.S.M., St. Mary's Hospital, Kansas City, Mo., for your RESERVATIONS.

Blank for hotel information and reservations on page 101.

For transportation, see your local agent for fares and routes.

American Society of Medical Technologists

Seventh Annual Convention

Headquarters

HOTEL JEFFERSON

MAY 18-19-20, 1939

Registration: May 18, 8 A. M. to 12 M.

Exhibits Open: 12 M. to 2 P. M., 4 P. M. to 8 P. M. Daily

THURSDAY, MAY 18, 9 A. M.

EXECUTIVE SESSION

INVOCATION

MINUTES OF 1938 CONVENTION

APPOINTMENT OF COMMITTEES

ANNOUNCEMENTS

PRESIDENT'S MESSAGE—Christine Seguin, Niles Center, Ill.

REPORTS:

Executive Committee—Vern L. Flannery, Chairman

American Journal of Medical Technology—John H. Conlin

Membership—John H. Conlin

Advisory Board—Marian A. Baker, Chairman

Treasurer—Hermine Tate

ADOPTION OF REPORTS

NEW BUSINESS

THURSDAY, MAY 18, 2 P. M.

(Free Afternoon—Planned by Entertainment Committee)

(Refer to Entertainment and Special Meetings, Page 100)

THURSDAY EVENING, MAY 18

(Refer to Entertainment and Special Meetings, Page 100)

FRIDAY, MAY 19, 9 A. M.

1. "Certain Aspects of Endocrinology from the Standpoint of the Medical Technician," ERNEST W. BLANCHARD, Ph.D., Research Chemist, Schieffelin & Co., New York City.
2. "Charts and Files in the Pathology Laboratory," PHYLLIS STANLEY, Presbyterian Hospital, Newark, N. J.
3. "Production of Immune Serum for Streptococcus Alpha Prime," DOROTHEA ZOLL, Research Institute, Lankenau Hospital, Philadelphia, Pa.
4. "The Usefulness and Responsibilities of Medical Technologists in the Practice of Medical Technology," CLARA BECTON, Hematology Technologist, St. Johns Hospital, Tulsa, Okla.
5. (Subject as yet unannounced). DR. S. W. BOHLS, Director of Laboratories, State Board of Health, Austin, Texas.

FRIDAY, MAY 19, 2 P. M.

BUSINESS SESSION
DISCUSSION OF NEW CONSTITUTION

FRIDAY EVENING, MAY 19, 7:30

SEVENTH ANNUAL BANQUET

SATURDAY, MAY 20, 9 A. M.

1. "Endameba Histolytica," MARIAN BAKER, Taylor Laboratory, Lufkin, Texas.
2. "Standardization of Laboratory Tests for Diagnosis of Syphilis," MARGARET R. HARRISON, Associate Chemist, Venereal Disease Research Laboratory, U. S. Marine Hospital, Staten Island, New York.
3. "The Future of Medical Technology," ROWENA JOHNSON, Tulsa, Okla.
4. "Filament Nonfilament Differential Count," IDA L. REILLY, Dixie Hospital, Hampton, Va.

SATURDAY, MAY 20, 2 P. M.

BUSINESS SESSION
ELECTION OF OFFICERS

SATURDAY EVENING, MAY 20

(Refer to Entertainment and Special Meetings, Page 100)

ENTERTAINMENT AND SPECIAL MEETINGS

WEDNESDAY, MAY 17

American Medical Association Exhibits
Counsellors' Meeting
Officers' Meeting

It is suggested by the Entertainment Committee that those desiring to attend the A.M.A. exhibits do so on Wednesday, the day before the start of the ASMT convention. Because of the increased amount of legislative procedure to be transacted this year, time has not been provided for this activity.

THURSDAY, MAY 18

3:00 P. M. Drive with stops at points of interest.

6:00 P. M. Dinner at the Castilla.

8:00 P. M. Mississippi River trip on the Capitol.

The afternoon of Thursday, May 18th a bus will leave the Jefferson Hotel at 3:00 P. M. for a drive that will include many points of interest. Stops will be made at the new Cathedral, Forest Park, the Art Museum, the Bear Pits, and the Jewel Box where an interesting floral display is on exhibit. The ride will end at the Hotel. At 6:00 P. M. that evening there will be an informal dinner at the Castilla, a Spanish type restaurant. Following the dinner the group will go by taxi to the wharf and a Mississippi River trip on the Capitol.

FRIDAY, MAY 19

7:30 P. M. Annual Banquet.

At 7:30 P. M. Friday, May 19th, the Annual Banquet will be held. Drs. J. H. Black and F. W. Konzelmann will be the speakers for this event and one of the many features of interest for the evening will be the announcement of awards by Dr. J. J. Moore. An exceptionally interesting and entertaining evening has been planned.

SATURDAY, MAY 20

7:00 P. M. Officers' meeting.

It will greatly facilitate entertainment plans if reservations for these various events are sent immediately to Catherine Smith, 3619 Paris Ave., St. Louis, Mo.

EXHIBITS AND EXHIBITORS

1. Dr. Pinkerton, St. Louis University, St. Louis, Mo.
   Color Photography.
2. Clara Weltge, Evangelical Deaconess Hospital, St. Louis, Mo.
   Museum Specimens.
3. Arkansas Society of M.T.'s with cooperation of the State Board of Health.
   Malaria.
4. Clara M. Becton, St. John's Hospital, Tulsa, Okla.
   Aids to Hematology.
5. Marguerite Lukens and Dr. Fred Boerner, Graduate Hospital, Philadelphia, Pa.
   Simplified Complement Fixation Test.
6. Ann Snadoz, Oklahoma City, Okla.
   Hematological Exhibit with Leukemias—Myelogenous.
7. Samuel Crabb, Black Hills Methodist Hospital, Rapid City, S. Dakota.
   Calculi and X-Rays.
8. Dr. R. B. Dienst, University of Georgia School of Medicine, Augusta, Ga.
   Use of Nigrosine in staining of Trepomena.
9. Theodore W. Keiper, Pamsetgaaf Laboratories, Prescott, Arizona.
   Monilia and Bronchomoniliasis.
10. Dr. B. B. Vincent Lyon, through courtesy of Miss F. A. Keen, Philadelphia, Pa.
    Atlas of Biliary Drainage microscopy (with possibility of fresh specimens for demonstration).
11. Sr. M. Eldetrude and Mr. C. H. Winbigler, St. Joseph's Hospital, St. Paul, Minn.
    Miscellaneous exhibit with Bacteriology, etc.
12. Catharine Hanitch, Hopkins, Minn.
    Modification of T.B. Stain.
13. Marion Baker, Taylor Clinic, Lufkin, Texas.
    Endameba Histolytica.
14. Phyllis Stanley, Presbyterian Hospital, Newark, N. J.
    Charts and Files in Laboratory.
15. Dr. Smith, Washington University, St. Louis, Mo.
    Exhibit promised, nature not certain.

HOTEL RESERVATIONS

TO: WM. H. SCHNEIDER, Convention Manager
Hotel Jefferson, Twelfth & Locust Sts., St. Louis, Mo.

PLEASE RESERVE FOR ME ACCOMMODATIONS AS CHECKED
AMERICAN SOCIETY OF MEDICAL TECHNOLOGISTS

☐ **Two Connecting Rooms with Bath Between for Two....$2.50 per Room**
☐ **Single Room with Bath.....$3.00, $3.50, $4.00, $4.50, $5.00, $5.50**
☐ **Double Rooms with Bath, Double Bed.....$4.00, $4.50, $5.00, $5.50, $6.00, $7.00, $7.50**
☐ **Double Rooms with Bath, Twin Beds.....$5.00, $6.00, $7.00, $7.50, $8.00**
☐ **Suites.....$6.00, $8.00, $10.00**

Check Style of Room Desired and Underscore Rate Rate $.....

Immediate reservation necessary to assure accommodations at your headquarters hotel

Be sure to give arrival and departure date.

Will arrive on (Date).....Will depart on (Date).....

Name.....

Street.....

City and State.....